

CLAIMS

I claim:

1. A oligonucleotide-based surface-enhanced Raman spectroscopy molecular probe (SMP), comprising:

at least one nanoparticle having at least a metal component, and

at least one pin loop, said pin loop including a loop sequence complementary to at least one target sequence, a first stem attached to one end of said pin loop having at least one SERS active label attached thereto and a second stem attached to the other end of said pin loop and said nanoparticle, wherein said probe generates a stronger SERS signal upon irradiation with excitation radiation when not bound to said target sequence as compared to a SERS signal following hybridization of said probe with said target sequence.

2. The SMP of claim 1, wherein said loop sequence includes at least one of DNA and PNA segments.

3. The SMP of claim 1, wherein said first and second stems are complementary sequences.

4. The SMP of claim 1, wherein said at least one pin loop comprises a plurality of said pin loops, said plurality of pin loops bound to at least one of said nanoparticles, said

plurality of pin loops providing at least two different of said loop sequences for simultaneously detecting a plurality of said target sequences.

5. The SMP of claim 1, wherein said at least one nanoparticle comprises a plurality of said nanoparticles bound to one another.

6. The SMP of claim 5, wherein said nanoparticles are bound to one another by DNA strands or thiol chemistry.

7. The SMP of claim 1, wherein said at least one SERS active label comprises at least a first and second SERS label, said first and second SERS label providing different emission characteristics.

8. The SMP of claim 1, wherein said SMP includes a bioreceptor attached thereto.

9. The SMP of claim 8, wherein said bioreceptor comprises at least one selected from the group consisting of an antibody, a protein, a gene, a biomimetic, an enzyme, a cell receptor and an intact biological cell.

10. A Raman detection system, comprising:
at least one excitation light source for providing excitation radiation, and

at least one oligonucleotide-based surface-enhanced Raman spectroscopy molecular probe (SMP), said SMP comprising at least one nanoparticle having at least a metal component, and at least one pin loop, said pin loop including a loop sequence complementary to at least one target sequence, a first stem attached to one end of said pin loop having at least one SERS active label attached thereto and a second stem attached to the other end of said pin loop and said nanoparticle, wherein said probe generates a stronger SERS signal upon irradiation with excitation radiation when not bound to said target sequence as compared to a SERS signal following hybridization of said probe with said target sequence.

11. The system of claim 10, further comprising a detection system communicably connected to said SMP for detection of SERS signals emanating from said SMP.

12. The system of claim 10, wherein said at least one SMP comprises a plurality of SMPs, said plurality of SMPs bound to a solid sampling platform.

13. The system of claim 11, wherein said detection system comprises at least one selected from the group consisting of a photomultiplier, a charge-coupled device (CCD), a charge injection device (CID), photodiode, phototransistor and avalanche diode.

14. The system of claim 11, wherein said detection system is integrated circuit based.

15. The system of claim 14, said at least one SMP comprises a plurality of SMPs, wherein said detection system provides a separate photodetector channel for receipt of SERS signals emanated from each of said plurality of SMPs.

16. The system of claim 11, wherein said at least one probe comprises a plurality of probes, said plurality of probes disposed in solution.

17. The system of claim 11, further comprising structure for application of energy sufficient to kill selected cells in a location proximate to any of said plurality of probes following detection of said target within a body.

18. The system of claim 17, wherein said selected cells comprise cancer cells.

19. The system of claim 11, wherein said at least one probe comprises a plurality of probes, said system further including a microfluidic system having a plurality of microfluidic channels, said microfluidic system for directing samples through said microfluidic channels to said plurality of probes.

20. The system of claim 19, wherein said microfluidic system comprises at least one selected from the group consisting of a capillary electrophoresis array, a liquid chromatography array, a gas chromatography array, and a lab-on-a-chip system.

21. The system of claim 11, wherein said at least one pin loop comprises a plurality of said pin loops bound to said nanoparticle, said plurality of pin loops providing at least two different of said loop sequences for simultaneously detecting a plurality of target sequences.

22. A method of detecting targets, comprising the steps of:
introducing at least one oligonucleotide-based surface-enhanced Raman spectroscopy molecular probe (SMP) to human or animal cells, said SMP comprising at least one nanoparticle having at least a metal component, and at least one pin loop, said pin loop including a loop sequence complementary to at least one target sequence, a first stem attached to one end of said pin loop having at least one SERS active label attached thereto and a second stem attached to the other end of said pin loop and said nanoparticle, wherein said probe generates a stronger SERS signal upon irradiation with excitation radiation when not bound to said target sequence as compared to a SERS signal following hybridization of said probe with said target sequence

irradiating said SMP, and
determining if said target sequence is present based on analysis of SERS radiation scattered by said SMP responsive to said irradiating step.

23. The method of claim 22, wherein said pin loop includes at least one of DNA and PNA segments.

24. The method of claim 22, further comprising the step of lysing said cells prior to said introducing step, wherein said method is performed *in-vitro*.

25. The method of claim 22, wherein said SMP is introduced into the body of said person or said animal, wherein said method is performed *in-vivo*.
26. The method of claim 25, wherein said SMP is injected into said body.
27. The method of claim 26, further comprising the step of driving said SMP inside at least a portion of said cells.
28. The method of claim 22, wherein detection of said target sequence indicates an abnormal gene sequence.
29. The method of claim 28, wherein said abnormal gene sequence comprises cancer.
30. The method of claim 22, wherein said determining step indicates the presence and position of an abnormal gene, further comprising the step of delivering energy to said position sufficient to kill at least some cells proximate to said position.
31. The method of claim 30, wherein said nanoparticle absorbs said energy and provides heat to said cells.
32. The method of claim 29, wherein said energy comprises IR radiation from 700 to 900 nm.

33. The method of claim 22, wherein said at least one pin loop comprises a plurality of said pin loops bound to said nanoparticle, said plurality of pin loops providing at least two different of said loop sequences, said determining step providing simultaneous detection for a plurality of said target sequences.